

# DECLARATION AND POWER OF ATTORNEY FOR U.S. PATENT APPLICATION

(X) Original      ( ) Supplemental      ( ) Substitute      ( ) PCT      ( ) Design

As a below named inventor, I hereby declare that: my residence, post office address and citizenship are as stated below next to my name; that I verily believe that I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural inventors are named below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

Title: POSITIVE-WORKING PHOTORESIST COMPOSITION

of which is described and claimed in:

(X) the attached specification, or

( ) the specification in the application Serial No. \_\_\_\_\_ filed \_\_\_\_\_;  
and with amendments through \_\_\_\_\_ (if applicable), or

( ) the specification in International Application No. PCT/ \_\_\_\_\_, filed \_\_\_\_\_, and as amended  
on \_\_\_\_\_ (if applicable).

I hereby state that I have reviewed and understand the content of the above-identified specification, including the claims, as amended by any amendment(s) referred to above.

I acknowledge my duty to disclose to the Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, §1.56.

I hereby claim priority benefits under Title 35, United States Code, §119 (and §172 if this application is for a Design) of any application(s) for patent or inventor's certificate listed below and have also identified below any application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

| COUNTRY | APPLICATION NO. | DATE OF FILING | PRIORITY CLAIMED |
|---------|-----------------|----------------|------------------|
| Japan   | 11-74097        | March 18, 1999 | Yes              |
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I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose information material to patentability as defined in Title 37, Code of Federal Regulations, §1.56 which occurred between the filing date of the prior application and the national or PCT international filing date of this application.

| APPLICATION SERIAL NO. | U.S. FILING DATE | STATUS: PATENTED, PENDING, ABANDONED |
|------------------------|------------------|--------------------------------------|
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|                        |                  |                                      |
|                        |                  |                                      |

And I hereby appoint Michael R. Davis, Reg. No. 25,134; Matthew M. Jacob, Reg. No. 25,154; Jeffrey Nolton, Reg. No. 25,408; Warren M. Cheek, Jr., Reg. No. 33,367; Nils E. Pedersen, Reg. No. 33,145 and Charles R. Watts, Reg. No. 33,142, who together constitute the firm of WENDEROTH, LIND & PONACK, L.L.P., attorneys to prosecute this application and to transact all business in the U.S. Patent and Trademark Office connected therewith.

I hereby authorize the U.S. attorneys named herein to accept and follow instructions from Agata Patent Office as to any action to be taken in the U.S. Patent and Trademark Office regarding this application without direct communication between the U.S. attorneys and myself. In the event of a change in the persons from whom instructions may be taken, the U.S. attorneys named herein will be so notified by me.

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I further declare that all statements made herein of my own knowledge are true, and that all statements on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

1st Inventor Kazufumi Sato Date Feb. 28. 2000.  
Kazufumi SATO  
2nd Inventor Satoshi Maemori Date February. 28. 2000  
Satoshi MAEMORI  
3rd Inventor Taku Nakao Date February. 28. 2000  
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5th Inventor \_\_\_\_\_ Date \_\_\_\_\_  
6th Inventor \_\_\_\_\_ Date \_\_\_\_\_  
7th Inventor \_\_\_\_\_ Date \_\_\_\_\_

The above application may be more particularly identified as follows:

U.S. Application Serial No. \_\_\_\_\_ Filing Date \_\_\_\_\_

Applicant Reference Number \_\_\_\_\_ Atty Docket No. \_\_\_\_\_

Title of Invention \_\_\_\_\_

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of :  
Kazufumi SATO et al. :  
Serial No. New :  
Filed :  
POSITIVE-WORKING PHOTORESIST :  
COMPOSITION

Rule 132 DECLARATION

Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Sir:

I, the undersigned Kazuyuki NITTA, do hereby declare:

THAT I am an employee of Tokyo Ohka Kogyo Co., Ltd., Japan, the assignee of the above-identified United States patent application, since April, 1990, being engaged in the research and development works relative to the chemical-amplification positive-working photoresist compositions and other related products of the company;

THAT, I am one of the joint inventors in the above-identified pending United States patent application, which is a divisional application from Serial No. 10/114,258 filed April 3, 2002, which in turn is a divisional application of Serial No. 09/521,205 filed March 8, 2000, I have full acquaintance with the subject matter of the above-identified pending application and have caused the comparative experiments described below either by myself or under my

direct supervision; and

THAT I have a good knowledge of the English language and have read and understood the application papers and the prosecution history of the antecedent applications as well as the Examiner's references cited therein.

## COMPARATIVE EXPERIMENTS

### I. Object of experiments

While claim 1 of the above-identified patent application requires that the ratio of the maximum weight-average molecular weight  $Mw_{max}$  to the minimum weight-average molecular weight  $Mw_{min}$  in the two resinous ingredients combined as the component (A) is smaller than 1.5, the object of the following comparative experiments is to demonstrate the significance of this limitation on the ratio as a characteristic parameter having great influences on the performance of the photoresist composition by conducting experiments using resinous ingredients having different values of this ratio.

### II. Experimental procedures and results

#### Experiment 1 (comparative).

A resinous ingredient as the component (A) having a  $Mw_{max}/Mw_{min}$  ratio of 1.6 was prepared as a 30:70 by weight combination of a first mixture of a polyhydroxystyrene resin having a weight-average molecular weight of 16000, of which 45% by moles of the hydroxyl hydrogen atoms were substituted by *tert*-butoxycarbonyl groups, and a polyhydroxystyrene resin having a weight-average molecular weight of 16000, of which 20% by moles of the hydroxyl hydrogen atoms were substituted by *tert*-butoxycarbonyl groups, in a mixing ratio of 65:35 by weight and a second resin mixture of a polyhydroxystyrene

resin having a weight-average molecular weight of 10000, of which 45% by moles of the hydroxyl hydrogen atoms were substituted by 1-ethoxyethyl groups, and a polyhydroxystyrene resin having a weight-average molecular weight of 10000, of which 25% by moles of the hydroxyl hydrogen atoms were substituted by 1-ethoxyethyl groups, in a mixing ratio of 75:25.

A positive-working photoresist composition was prepared by dissolving, in 490 parts by weight of propyleneglycol monomethyl ether, 100 parts by weight of the above-prepared component (A) having a  $Mw_{max}/Mw_{min}$  ratio of 1.6, 7 parts by weight of bis(cyclohexylsulfonyl) diazomethane as the component (B), 0.1 part by weight of triethylamine and 0.5 part by weight of salicylic acid as an additive followed by filtration of the solution through a membrane filter of 0.2  $\mu m$  pore diameter.

The thus prepared photoresist solution was subjected to the evaluation tests for the testing items (1) to (5) in the same manner as in the application to give the following results:

- (1) 12 mJ/cm<sup>2</sup> of the photosensitivity;
- (2) grade A of the cross sectional profile of the patterned resist layer;
- (3) 0.18  $\mu m$  of the pattern resolution;
- (4) 2060 per wafer of the surface defects, and
- (5) grade A of the heat resistance.

#### Experiment 2 (comparative)

The experimental procedure was substantially the same as in Experiment 1 described above except that the component (A) having a  $Mw_{max}/Mw_{min}$  ratio of 1.8 instead of 1.6 was a 30:70 by weight combination of a first resin mixture consisting of a polyhydroxystyrene resin having a weight-average molecular weight of 9000, of which 45% by moles of the hydroxyl hydrogen

atoms were substituted by *tert*-butoxycarbonyl groups, and a polyhydroxystyrene resin having a weight-average molecular weight of 9000, of which 20% by moles of the hydroxyl hydrogen atoms were substituted by *tert*-butoxycarbonyl groups, in a mixing ratio of 65:35 by weight and a second resin mixture consisting of a polyhydroxystyrene resin having a weight-average molecular weight of 5000, of which 45% by moles of the hydroxyl hydrogen atoms were substituted by 1-ethoxyethyl groups, and a polyhydroxystyrene resin having a weight-average molecular weight of 5000, of which 25% by moles of the hydroxyl hydrogen atoms were substituted by 1-ethoxyethyl groups, in a mixing ratio of 75:25 by weight. The results of the evaluation tests for the testing items (1) to (5) were as follows:

- (1) 12 mJ/cm<sup>2</sup> of the photosensitivity;
- (2) grade A of the cross sectional profile of the patterned resist layer;
- (3) 0.18  $\mu$ m of the pattern resolution;
- (4) 3200 per wafer of the surface defects, and
- (5) grade A of the heat resistance.

#### Experiment 3 (inventive)

The experimental procedure was substantially the same as in Experiment 1 described above except that the component (A) of the photoresist composition having a  $MW_{\max}/MW_{\min}$  ratio of 1.3 was a 30:70 by weight combination of a first resin mixture consisting of a polyhydroxystyrene resin having a weight-average molecular weight of 13000, of which 45% by moles of the hydroxyl hydrogen atoms were substituted by *tert*-butoxycarbonyl groups, and a polyhydroxystyrene resin having a weight average molecular weight of 13000, of which 20% by moles of the hydroxyl hydrogen atoms were substituted by *tert*-butoxycarbonyl groups, in a mixing ratio of 60:40 by weight and a second resin mixture consisting of a polyhydroxystyrene

resin having a weight-average molecular weight of 10000, of which 45% by moles of the hydroxyl hydrogen atoms were substituted by 1-ethoxyethyl groups, and a polyhydroxystyrene resin having a weight average molecular weight of 10000, of which 25% by moles of the hydroxyl hydrogen atoms were substituted by 1-ethoxycyethyl groups, in a mixing ratio of 70:30 by weight. The results of the evaluation tests of the photoresist composition for the testing items (1) to (5) were as follows:

- (1) 12 mJ/cm<sup>2</sup> of the photosensitivity;
- (2) grade A of the cross sectional profile of the patterned resist layer;
- (3) 0.17  $\mu$ m of the pattern resolution;
- (4) 9 per wafer of the surface defects, and
- (5) grade A of the heat resistance.

#### Conclusion

As is clearly understood from the above-described results of the comparative experiments, the claimed upper limit of 1.5 for the  $Mw_{max}/Mw_{min}$  ratio of the resinous ingredients constituting the component (A) of the photoresist composition is critical on the quality of the patterned resist layer formed from the photoresist composition in respect of the pattern resolution and, in particular, the number of surface defects with so great differences between Experiment 3 (inventive) and Experiment 1 or 2 (comparative).

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title



18 of the United States Code and that such willful false statements may jeopardize the validity of any application or any patent issued thereon.

Date: October 22, 2003

Kazuyuki Nitta  
Kazuyuki NITTA